Summary of a scientific experiment by Dr. Fennell, M.Sc., Ph.D., P.Geol. Hydrogeologist & Geochemist, see attached report and data for the complete results.

An experiment was conducted on a sample of sand and gravel obtained from Burnco's current West Cochrane Pit. This pit is part of a large development currently under review by Rocky View County. The area extends for 6 or more kilometers along the Bow River approximately 7km west on Highway 1A from the Highway 1A/22 intersection. The purpose of this experiment was to assess what type of changes to water quality might occur after flowing deionized water these sediments. The purpose was to mimic the infiltration of snowmelt and/or rainfall through a thin (1.25m) column of soil (see Figure 1).

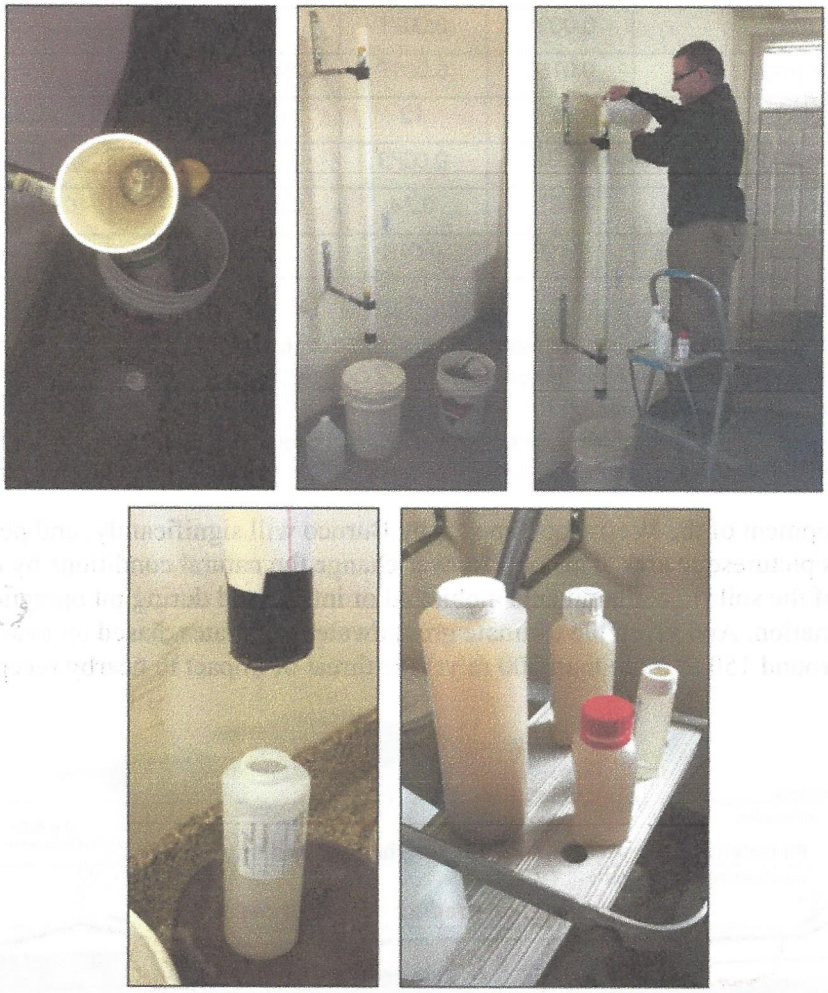


Figure 1. Experimental setup, execution, and sample turbidity noted.

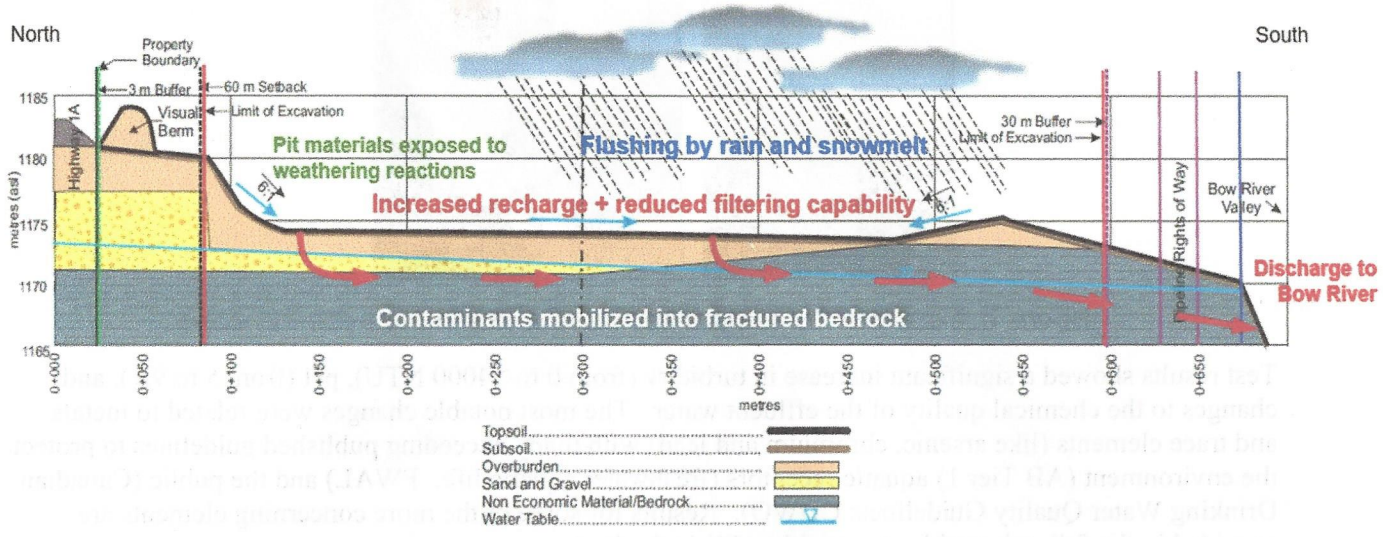
Test results showed a significant increase in turbidity (from 0 to >4000 NTU), pH (from 5 to 9.1), and changes to the chemical quality of the effluent water. The most notable changes were related to metals and trace elements (like arsenic, chromium and lead) with many exceeding published guidelines to protect the environment (AB Tier 1) aquatic receptors (freshwater aquatic life: FWAL) and the public (Canadian Drinking Water Quality Guidelines: CDWQ). Results for some of the more concerning elements are provided in the following table along with published criteria.

Parameter	Soil flush #1	Soil flush #2	AB Tier 1	AB FWAL	CDWQ
Turbidity (NTU)	>4000	1600	--	2	1
Aluminum (mg/L	6.1	4.0	0.05		<0.1 OG
Arsenic (mg/L	0.019	0.009	0.005	0.005	0.010 ALARA
Cadmium (µg/L)	0.53	0.44	0.34*		--
Chromium (mg/L)	0.013	0.020	0.001+ 0.0049++	0.001+ 0.0089++	0.05 MAC
Cobalt (mg/L)	0.0095	0.0071	0.0015*		--
Copper (mg/L)	0.0150	0.0097	0.0070	0.0390	2 AO
Iron (mg/L)	17	12	0.3		≤0.3 AO
Lead (mg/L)	0.010	0.0073	0.007*		0.005 ALARA
Manganese (mg/L)	0.81	0.74	0.05	--	0.12 MAC
Zinc (mg/l)	0.120	0.073	0.030		5.0 AO

Notes:

1. Values indicated for protection of freshwater aquatic life relate to long-term exposure.
2. * Assumes a groundwater hardness of 250 mg/L (as $CaCO_3$).
3. + = hexavalent; ++ = trivalent.
4. MAC = maximum acceptable value; ALARA = as low as reasonably achievable; AO = aesthetic value; OG = operational guidance value.

The proposed development of the West Cochrane Pit by Burnco will significantly, and permanently, alter the landscape of this picturesque area. This will forever change the natural conditions by eliminating the filtering capability of the soils to contaminants mobilized or introduced during pit operation and following site reclamation. And given the estimate groundwater flow rates, based on available site information (from around 150 to more than 600 m/yr) the threat of impact to nearby receptors is notable.



Exposing sand, gravel, and bedrock to weathering and flushing has the potential to increase risk to the local environment due to the mobilization or introduction of contaminants. Not only will fish-bearing streams like the Bow River be put at risk, but also the drinking water supplies of downstream communities. If this is not properly assessed we are placing ourse4lves and the environment at risk. Unfortunately, we are left with more questions than answers. And for such a highly intrusive, visually unappealing, and extremely disruptive project wouldn't you want to know?

The concern with the current application before Rocky View County is that it does nothing to assess the impacts that may occur around a VERY LARGE gravel pit development, despite the need to clarify these outstanding questions and concerns.

Why is it always have to be left up to the public to seek the truth about such gravel developments?

Why can't proponents do a more thorough job of assessing the risks?

June 18, 2021

Attention: To whom it may concern

Re: West Cochrane Pit soil column flushing experiment

The following is a summary of the experiment conducted on a sample of sand and gravel obtained from Burnco's currently operating West Cochrane Pit, located approximately 7 km west on Highway 1A from the Highway 1A/22 intersection. The purpose of this test was to assess the possible physical and chemical changes that may occur to water (i.e. precipitation) flowing through these sediments, both during and after development, and entering the local groundwater.

Methodology

A sample of sand and gravel was procured from the Burnco West Cochrane Pit for testing. Once delivered, a subset of that sand and gravel was placed in a newly purchased, and cleaned, plastic 20L pail for delivery to the point of testing. On 08 May 2021 a representative aliquot of the sand and gravel, comprising a mixture of clay, silt, sand and cobbles, was loaded into a pre-cleaned 1.5 m x 51 mm ID PVC pipe to mimic a vertical soil column beneath the Burnco pit area. A pre-cleaned plastic container was used to load the sample into the PVC pipe to avoid the use of any metallic equipment. Prior to loading the sample, the base of the PVC pipe was covered with clean fibreglass mesh to retain the soil sample the pipe. Once in place, settling of the sediment was achieved by tapping the outside of the pipe with a small hammer to compact the material towards natural in-situ conditions.

Laboratory-grade deionized water was obtained from the contacted laboratory (Bureau Veritas, BV) to react with the soil mixture in the column. Prior to adding the deionized water, the length of the sediment column was measured

indicating a 1.25 m vertical thickness. When ready the soil column was slowly hydrated with the deionized water to mimic infiltration of precipitation. Once the water began draining from the base of the PVC pipe, unfiltered samples were collected into bottles provided by BV (i.e. HDPE and glass, where required).

An initial set of samples (Soil flush #1) was collected on 08 May 2021 at 11:30AM. Once obtained and properly labelled the samples were placed in a refrigerator. The soil column was then allowed to drain over-night and a second set of samples (Soil flush #2) was collected the following day, 09 May 2021 at 10:45AM, using the same deionized water flow-through procedure.

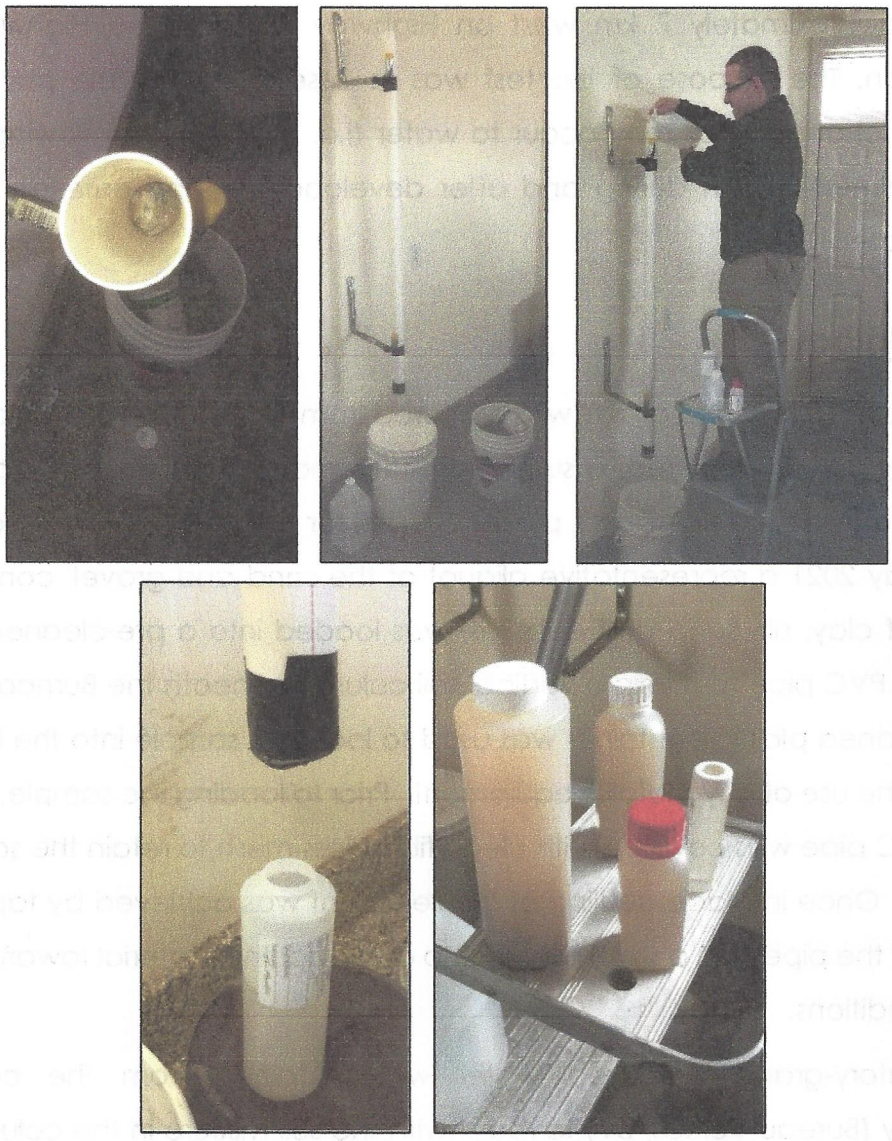


Figure 1. Experimental setup, execution, and sample turbidity noted.

Upon completion of testing, both sample sets were placed in an ice-filled cooler to maintain their integrity while in transit to BV in northeast Calgary AB. Stand chain-of-custody (CoC) protocols were followed to track the shipping and handling process. Delivery was made within 48 hours for the first set of samples, and 24 hrs for the second set. A copy of the completed CoC is provided in Appendix 1. During the testing procedure, photographs were taken to document the process. Visual turbidity of the samples was noted at the time, as indicated in the photographs provided in Figure 1.

Analytical program

A relatively comprehensive analytical program was executed to assess changes to the deionized water quality following its transit through the soil column. Analysis was completed for the following:

- pH, alkalinity, and hardness,
- major ions (calcium, magnesium. sodium, potassium, bicarbonate + carbonate, sulphate, and chloride),
- nitrate and nitrite,
- metals and trace elements (including mercury), and
- turbidity.

All samples were received in good order, as documented by BV on the CoC. Sample temperatures were logged in at less than the require 10°C threshold and were received within the required time limit for sensitive parameters including turbidity and nitrate+ nitrite. The high quality of the deionized water was confirmed by BV (Appendix 1). A Certificate of Analysis for the two tests was also provided (Appendix 2).

Results

As noted in Appendix 1, the deionized water used for the testing was devoid of any particulate or dissolved constituents, much like natural precipitation. Measurement with a hand-held TDS meter confirmed a "zero" mineralization. The pH and temperature were also measured at the time of testing with a combination

hand-held meter and returned values of 5 to 6 and 13°C to 14°C, respectively, on both days.

After confirming the starting conditions of the deionized water, the water was slowly flowed through the sediment column. Samples collected from the base were very different in appearance compared to the water that was added at the top. Of particular note was the colour and turbidity as indicated in the lower right image of Figure 1. The occurrence of such turbidity is surprising considering the assumption often made that fine particles will be strained or filtered out as the water flows through the subsurface. However, this was obviously not the case. Measured values for Soil flush #1 and Soil flush #2 were >4000 NTU and 1600 NTU, respectively (Appendix 2).

In addition to turbidity, the chemical quality of the deionized water was also notably changed after reacting with the soil mixture. For example, the total dissolved solids (TDS) content increased from a pre-test value of 0 mg/L to 47 mg/L for Soil flush #1 and to a value of 39 mg/L for Soil flush #2. The laboratory pH also increased significantly to 9.1 for both tests. This represents a change from mildly acidic to alkaline conditions following a rather short reaction time, and is indicative rapid reactions occurring as the water flowed through the soil mixture (e.g. ion exchange).

Prior to conducting further data evaluation a check on the correctness of analysis was performed. This included a review of the anion-cation charge balance to confirmed acceptability. The values obtained for both samples (-1.1% and 1.9%, respectively) were within the recommended standard of ±2%[1]. An additional test was performed where the ratio of reported TDS versus calculated TDS was assessed. The range of acceptability is between 1.0 to 1.2[1], and the values obtained for the two soil flush tests were 1.01 and 1.00, respectively. Based on these confirmations the results from both tests were considered acceptable for further evaluation.

Other changes that occurred to the deionized water were less visual and more chemical in nature, with some of the constituents returning values in excess of

[1] *Standard Methods for the Examination of Water and Wastewater*

published water quality criteria. The criteria used for comparison in this study included:

- Alberta Tier 1 Soil and Groundwater Remediation Guidelines – for agricultural land (Alberta Government 2019)
- Environmental Quality Guidelines for Alberta Surface Waters – for the protection of freshwater aquatic life - FWAL (Alberta Government 2018)
- Guidelines for Canadian Drinking Water Quality - CDWQ (Health Canada 2020)

The following table summarizes a number of parameters in the soil flush effluent that exhibited values in excess of the above-noted criteria:

Parameter	Soil flush #1	Soil flush #2	AB Tier 1	AB FWAL	CDWQ
Turbidity (NTU)	>4000	1600	--	2	1
Aluminum (mg/L	6.1	4.0	0.05		<0.1 OG
Arsenic (mg/L	0.019	0.009	0.005	0.005	0.010 ALARA
Cadmium (µg/L)	0.53	0.44	0.34*		--
Chromium (mg/L)	0.013	0.020	0.001^{+} 0.0049^{++}	0.001^{+} 0.0089^{++}	0.05 MAC
Cobalt (mg/L)	0.0095	0.0071	0.0015*		--
Copper (mg/L)	0.0150	0.0097	0.0070	0.0390	2 AO
Iron (mg/L)	17	12	0.3		≤0.3 AO
Lead (mg/L)	0.010	0.0073	0.007*		0.005 ALARA
Manganese (mg/L)	0.81	0.74	0.05	--	0.12 MAC
Zinc (mg/l)	0.120	0.073	0.030		5.0 AO

Notes:

1. Values indicated for protection of freshwater aquatic life relate to long-term exposure.
2. * Assumes a groundwater hardness of 250 mg/L (as $CaCO_3$).
3. $^{+}$ = hexavalent; $^{++}$ = trivalent.
4. MAC = maximum acceptable value; ALARA = as low as reasonably achievable; AO = aesthetic value; OG = operational guidance value.

Measured values for the other constituents analyzed are provided in Appendix 2. However, those listed in the preceding table represent the most notable in terms of risk to human and ecological receptors.

Discussion

The proposed development of the West Cochrane Pit by Burnco will significantly, and permanently, alter the natural landscape of this picturesque area. Although Burnco indicates that the anticipated change to the local groundwater and surface water will be negligible, that claim has not actually been substantiated. Baseline groundwater quality was established by Burnco back in 2018, but no follow-up water quality monitoring has been communicated since. This includes in and around the currently operating pit area, which was commissioned following the 2018 program.

In light of the results generated by this experiment, concern exists that particulate matter and dissolved constituents will be mobilized from disturbed areas into the local groundwater and any receiving water bodies. Given the range of hydraulic conductivity values measured for the sand and gravel at the site (pdf page 773-75 of the Burnco's MSDP: 4.8 to 25.6 m/d), a calculated lateral hydraulic gradient of 0.028 from the Matrix's supporting report, and an assumed effective porosity of 30%, the flow of groundwater beneath the site could range anywhere from around 150 m/yr to more than 600 m/yr (depending on local conditions). Therefore the transit time for a substance released to reach a receptors would be relatively short at less than a year to perhaps a year or so.

Stripping of the overlying topsoil and removal of a substantial amount of the sand and gravel beneath will inevitably reduce the filtering capacity of the subsurface and allow contaminants that occur during the mining process (natural or other) to move more quickly down to the water table. This is shown in conceptual manner in Figure 2 on the following page, and is reinforced by a statement made by Matrix Solutions in an excerpt from Burnco's 2020 Master Site Development Plan (MSDP pdf page 682 of 1882):

The removal of the silty clay (where present) at site, will remove a natural barrier to potential contamination of the groundwater from surface spills. Any contaminant spilled at surface during or after operations would preferentially flow either vertically through the porous gravel and bedrock to the water table or along preferentially pathways (secondary permeability/fractures) in the bedrock. From below the water table it would follow groundwater flow direction (south to southeast), likely ending up in the Grande Valley Creek, Beaupré Creek, and the Bow River. Any contamination could potentially flow into the underlying bedrock, posing a risk to any residential well users in the area.

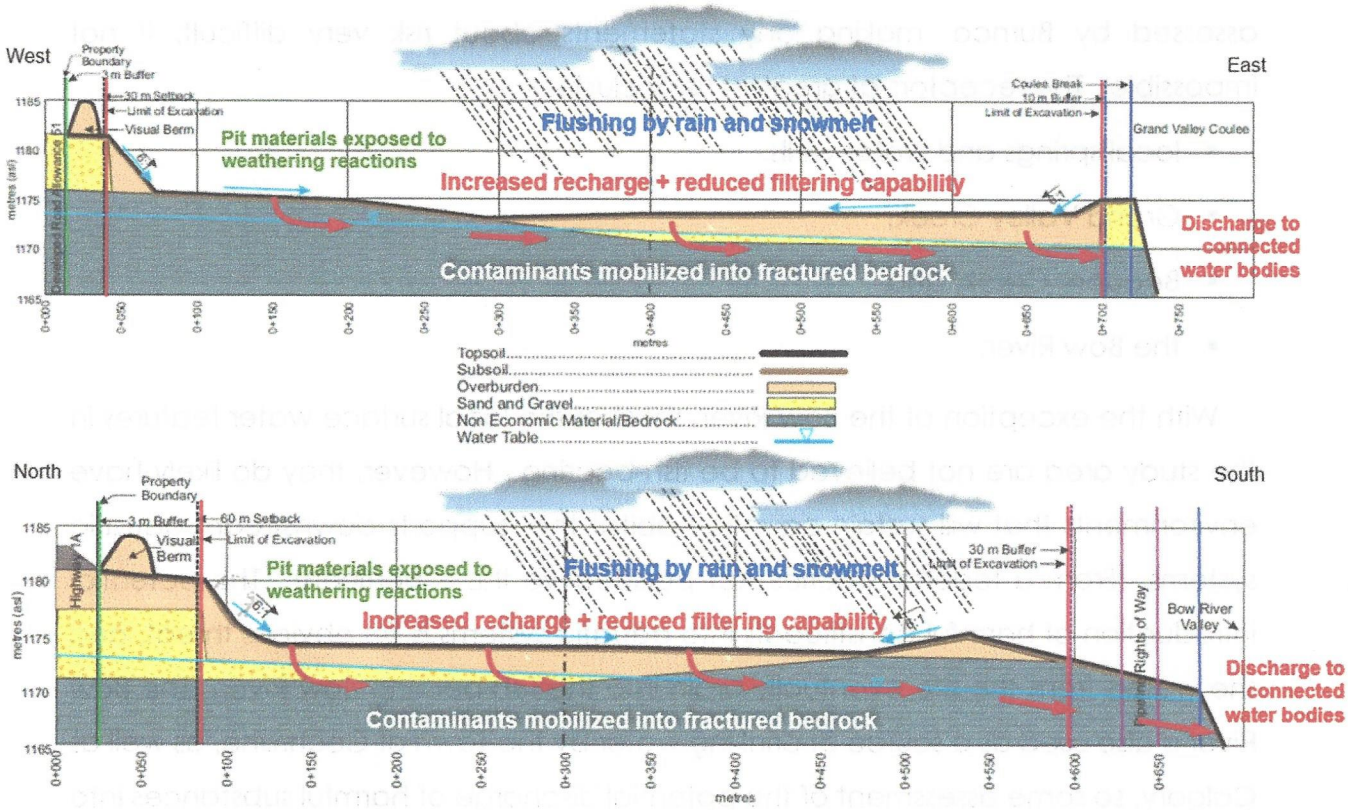


Figure 2. Conceptual diagram showing change to site conditions from pit development and associated risk to aquatic receptors.

Recharging precipitation (snow melt or rain) entering the subsurface will enhance the ability to move particulate and dissolved matter into the groundwater. By removing the filtering capacity of sediment this will only exacerbate the situation. It is clear from this experiment that turbidity can be mobilized by flushing water thought a 1.25 m soil column, not to mention notable changes to the chemical quality of the effluent.

The findings of this study suggest that the action of mining gravel from a very large development area will ultimately expose the remaining sand and gravel, as

well as the underlying bedrock aquifers, to weathering reactions and enhanced flushing by annual snow melt and rainfall events.

As such, any contaminants (solid or dissolved) mobilized and flushed from these exposed sediments will increase the risk of impact to the local environment. Proximity to receptors will be a major factor, not to mention how the mobilized contaminants move through the subsurface. However, this aspect has not been assessed by Burnco, making any statements about risk very difficult, if not impossible. The receptors at greatest risk include:

- local springs and water wells,
- Grand Valley Creek,
- Beaupre Creek, and
- the Bow River.

With the exception of the Bow River, most of the local surface water features in the study area are not believed to be fish-bearing. However, they do likely have environments that will sustain aquatic habitat that supports downstream aquatic systems. From a federal *Fisheries Act* perspective this is pertinent. The potential introduction of harmful constituents into aquatic systems is an obvious threat, and the waters from the site eventually drain into the fish-bearing Bow River. The Bow River is also used as a source of drinking water by the Town of Cochrane, as well as Calgary, so some assessment of the potential discharge of harmful substances into the river should have been conducted. However, it was not.

The turbidity guideline for protection of aquatic life in Alberta requires that the maximum long-term average for "clear" water systems, like the West Cochrane Pit area, be kept within 8 NTU above background values for any short-term exposure (e.g. up to 24 hours). Over the longer-term the increase should be no more than 2 NTU above background levels (Alberta Government 2018).

The way in which Burnco mines the sand and gravel deposit will also dictate the end result regarding risk to the local groundwater and connected systems. It is understood that a thin veneer of sand and gravel deposit will be left in place. All of this granular material rests in contact with fractured bedrock as noted in Burnco's

MSDP, submitted in June 2020. Based on the findings of this study, mobilization of turbidity from any residual sand and gravel left above the bedrock is a risk. Once in the fractured bedrock it will have a reduced chance of being attenuated, as fracture flow is very different than flow though porous media. Again, this aspect was not assessed.

If Burnco decides to operate a wet pit instead, and mine below the water table without dewatering, this will likely occur via bailing operations. The effect of this extraction method will be to create very turbid water due to the churning action of the excavation equipment. Again, the migration of mobilized particulate matter through the sediments is likely. Mobilization of turbidity in local groundwater has been documented before, with measurable effects being noted as far as 1.8 km downgradient. The following quote is taken from a report authored by Mead (1995):

> *"This DEQ [Department of Environmental Quality] study found a turbidity plume that extended more than a mile to the north (downgradient) of the gravel operation. The average turbidity of the water being discharged from the washing operation into the pond at the site was 2,737 nephelometric turbidity units (NTUs). Nearly all wells sampled within the first 6,000 feet of the turbidity plume were measured at 5 NTU or more. Many wells within the first 3,000 feet of the plume had turbidity levels of 10 NTU or more. Nearly all wells outside the plume had turbidities of 2 NTU or less."*

Additionally, the release of harmful metals and trace elements is a concern. This is not only associated with the type of metal or trace element mobilized, like arsenic or lead, but also the form it takes when present in the water. Given the anticipated groundwater conditions beneath the Burnco development area (i.e. well oxygenated and at a pH of 7 to 8, as noted on pdf page 699 in Burnco's MSDP) the speciation of chromium, for example, would favour the more mobile chromate ion (i.e. CrO_4^{2-}).

When present as chromate, and at the groundwater conditions described previously, it will be present in the hexavalent form (the more toxic form). This is shown in the Eh-pH diagram provided in Figure 3. Hexavalent chromium is a highly toxic species, and can influence aquatic life at values as low as 0.001 mg/L. The

other metals and trace elements noted in the summary table on page 5 will have their own unique toxicity and mobility characteristics.

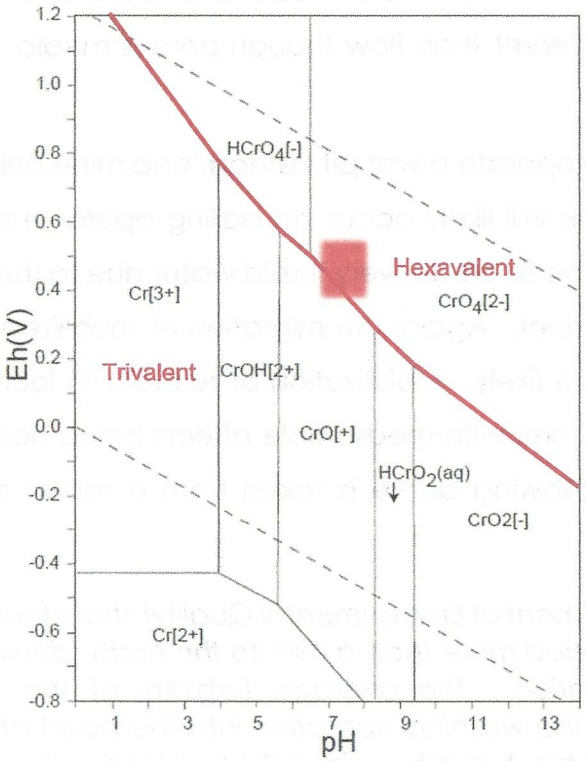


Figure 3. Eh-pH diagrams for chromium (left) and selenium (right)[2].
Note: red shaded area represents conditions expected in well-oxygenated groundwater system.

Unfortunately, none of the required information to assess this aspect has been provided. In fact, there is no monitoring data available for any of the wells around the working gravel pit to determine what constituents may have been mobilized so far. The only location assessed for metals and trace elements back in 2018 was a monitoring well located upgradient of the operating pit and adjacent to Highway 1A, that being MW18-02(B2).

The concern with the Burnco's current application to Rocky View County is that it does nothing to assess the impacts to groundwater and connected surface water environments that could occur around a working gravel pit. Although there are monitoring wells established around the current open pit, no up-to-date information is available to assess what has occurred since commissioning of that pit. Of equal

[2] *Geological Survey of Japan*

importance is the lack of assessment done to determine what the full impact of the West Cochrane Pit will look like once development is complete and reclamation has occurred.

Given the results of this soil column test there should be cause for concern. The pit mining activities will be located very close to aquatic receptors and therefore pose a threat to their existence and future viability. At the very least Burnco should be required to conduct a proper risk assessment and account for the potential mobilization, transport, and fate of contaminants like the ones documented in this experiment. It would also be informative for Burnco to assess conditions around their existing West Cochrane Pit via the series of dedicated monitoring wells installed there. This should include a proper assessment of water quality and geochemical conditions to better understand the risks involved if mining is to be extended across the larger proposed development area. Unfortunately, none of this work has been completed or provided for decision makers to rely on. This begs the questions:

"To what degree will Burnco's proposed development impact the groundwater quality across the larger area?"

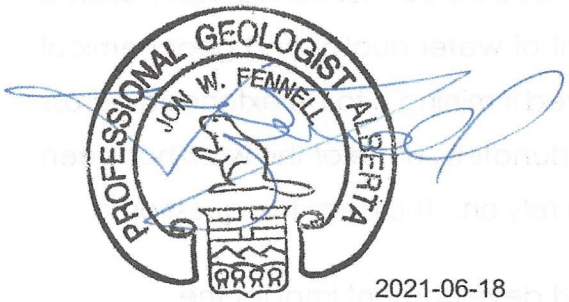
and

"How will this impact downgradient receptors like Grand Valley Creek, Beaupre Creek, and ultimately the Bow River?"

Closure

This report has been prepared to summarize results of a soil column flushing experiment designed to mimic infiltration of snowmelt and rainwater through sand and gravel deposits beneath the West Cochrane Pit area. The content is meant to inform decision makers so that unintended consequences to the environment and downstream communities can be avoided. If there are any questions regarding the methodology or interpretation of findings provided herein, the reader should contact the undersigned for clarification.

Respectfully submitted by:



2021-06-18

Jon Fennell, M.Sc., Ph.D., P.Geol.
Hydrogeologist & Geochemist

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APPENDIX 1

Deionized water quality (from Bureau Veritas):

QA/QC Batch	QC Type	Parameter	Date Analyzed	Value	UNITS
A221986	Method Blank	Turbidity	2021/05/12	<0.10	NTU
		Total Mercury (Hg)	2021/05/12	<0.0019	ug/L
		Total Barium (Ba)	2021/05/16	<0.010	mg/L
		Total Boron (B)	2021/05/16	<0.020	mg/L
		Total Calcium (Ca)	2021/05/16	<0.30	mg/L
		Total Iron (Fe)	2021/05/16	<0.060	mg/L
		Total Lithium (Li)	2021/05/16	<0.020	mg/L
		Total Magnesium (Mg)	2021/05/16	<0.20	mg/L
		Total Manganese (Mn)	2021/05/16	<0.0040	mg/L
		Total Phosphorus (P)	2021/05/16	<0.10	mg/L
		Total Potassium (K)	2021/05/16	<0.30	mg/L
		Total Silicon (Si)	2021/05/16	<0.10	mg/L
		Total Sodium (Na)	2021/05/16	<0.50	mg/L
		Total Strontium (Sr)	2021/05/16	<0.020	mg/L
		Total Sulphur (S)	2021/05/16	<0.20	mg/L
		Total Aluminum (Al)	2021/05/14	<0.0030	mg/L
		Total Antimony (Sb)	2021/05/14	<0.00060	mg/L
		Total Arsenic (As)	2021/05/14	<0.00020	mg/L
		Total Beryllium (Be)	2021/05/14	<0.0010	mg/L
		Total Chromium (Cr)	2021/05/14	<0.0010	mg/L
		Total Cobalt (Co)	2021/05/14	<0.00030	mg/L
		Total Copper (Cu)	2021/05/14	<0.00020	mg/L
		Total Lead (Pb)	2021/05/14	<0.00020	mg/L
		Total Molybdenum (Mo)	2021/05/14	<0.00020	mg/L
		Total Nickel (Ni)	2021/05/14	<0.00050	mg/L
		Total Selenium (Se)	2021/05/14	<0.00020	mg/L
		Total Silver (Ag)	2021/05/14	<0.00010	mg/L
		Total Thallium (Tl)	2021/05/14	<0.00020	mg/L
		Total Tin (Sn)	2021/05/14	<0.0010	mg/L
		Total Titanium (Ti)	2021/05/14	<0.0010	mg/L
		Total Uranium (U)	2021/05/14	<0.00010	mg/L
		Total Vanadium (V)	2021/05/14	<0.0010	mg/L
		Total Zinc (Zn)	2021/05/14	<0.0030	mg/L
		Dissolved Sodium (Na)	2021/05/13		%
		Dissolved Calcium (Ca)	2021/05/13	<0.30	mg/L
		Dissolved Iron (Fe)	2021/05/13	<0.060	mg/L
		Dissolved Magnesium (Mg)	2021/05/13	<0.20	mg/L
		Dissolved Manganese (Mn)	2021/05/13	<0.0040	mg/L
		Dissolved Potassium (K)	2021/05/13	<0.30	mg/L
		Dissolved Sodium (Na)	2021/05/13	<0.50	mg/L
		Dissolved Calcium (Ca)	2021/05/13	<0.30	mg/L
		Dissolved Iron (Fe)	2021/05/13	<0.060	mg/L
		Dissolved Magnesium (Mg)	2021/05/13	<0.20	mg/L
		Dissolved Manganese (Mn)	2021/05/13	<0.0040	mg/L
		Dissolved Potassium (K)	2021/05/13	<0.30	mg/L
		Dissolved Sodium (Na)	2021/05/13	<0.50	mg/L
		Dissolved Nitrite (N)	2021/05/12	<0.010	mg/L
		Alkalinity (PP as CaCO3)	2021/05/14	<1.0	mg/L
		Conductivity	2021/05/14	<2.0	uS/cm
		Dissolved Chloride (Cl)	2021/05/14	<1.0	mg/L

APPENDIX 2

(see attached PDF)

Your C.O.C. #: 635648-01-01

Attention: John Fennell

COMMERCIAL ACCOUNTS - CALGARY BUREAU VERITAS CANADA (2019) INC.
4000 19th Street NE
Calgary, AB
CANADA T2E 6P8

Report Date: 2021/05/31
Report #: R3026392
Version: 3 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C130760
Received: 2021/05/10, 08:10

Sample Matrix: Water
Samples Received: 2

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	2	N/A	2021/05/14	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME (Total)	2	N/A	2021/05/14		Auto Calc
Chloride/Sulphate by Auto Colourimetry	2	N/A	2021/05/15	AB SOP-00020	SM23-4500-Cl/SO4-E m
Conductivity @25C	2	N/A	2021/05/14	AB SOP-00005	SM 23 2510 B m
Hardness	1	N/A	2021/05/14		Auto Calc
Hardness	1	N/A	2021/05/16		Auto Calc
Mercury (Total) by CV	1	2021/05/12	2021/05/12	AB SOP-00084	BCMOE BCLM Oct2013 m
Elements by ICP-Dissolved-Lab Filtered (1)	2	N/A	2021/05/13	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	2	2021/05/12	2021/05/16	AB SOP-00014 / AB SOP-00042	EPA 6010d R5 m
Elements by ICPMS - Total	2	2021/05/12	2021/05/13	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	1	N/A	2021/05/15		Auto Calc
Ion Balance	1	N/A	2021/05/16		Auto Calc
Sum of cations, anions	1	N/A	2021/05/14		Auto Calc
Sum of cations, anions	1	N/A	2021/05/16		Auto Calc
Nitrate and Nitrite	2	N/A	2021/05/14		Auto Calc
NO2 - NO2 + NO3 (N) in Water	2	N/A	2021/05/12	AB SOP-00091	SM 23 4500 NO3m
Nitrate (as N)	2	2021/05/11	2021/05/14		Auto Calc
pH @25°C (2)	2	N/A	2021/05/14	AB SOP-00005	SM 23 4500-H+B m
Total Dissolved Solids (Calculated)	1	N/A	2021/05/15		Auto Calc
Total Dissolved Solids (Calculated)	1	N/A	2021/05/16		Auto Calc
Turbidity	2	N/A	2021/05/12	CAL SOP-00081	SM 23 2130 B m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession ng accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement

Your C.O.C. #: 635648-01-01

Attention: John Fennell

COMMERCIAL ACCOUNTS - CALGARY BUREAU VERITAS CANADA (2019) INC.
4000 19th Street NE
Calgary, AB
CANADA T2E 6P8

Report Date: 2021/05/31
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CERTIFICATE OF ANALYSIS – REVISED REPORT

BV LABS JOB #: C130760
Received: 2021/05/10, 08:10

Uncertainty has not been accounted for when stating conformity to the referenced standard.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for iso* dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(2) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

Encryption Key

Bureau Veritas
31 May 2021 15:09:14

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Customer Solutions, Western Canada Customer Experience Team
Email: customersolutionswest@bureauveritas.com
Phone# (403) 291-3077

==========

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

ROUTINE WATER -LAB FILTERED (WATER)

BV Labs ID		ZT5148	ZT5149	
Sampling Date		2021/05/08 11:30	2021/05/09 10:45	
COC Number		635648-01-01	635648-01-01	
	UNITS	SOIL FLUSH #1	SOIL FLUSH #2	RDL
Calculated Parameters				
Anion Sum	meq/L	0.93	0.81	N/A
Cation Sum	meq/L	0.91	0.78	N/A
Hardness (CaCO3)	mg/L	39	35	0.50
Ion Balance (% Difference)	%	NC	NC	N/A
Dissolved Nitrate (N)	mg/L	0.10	0.058	0.010
Dissolved Nitrate (NO3)	mg/L	0.45	0.26	0.044
Dissolved Nitrite (NO2)	mg/L	<0.033	<0.033	0.033
Calculated Total Dissolved Solids	mg/L	47	39	10
Misc. Inorganics				
Conductivity	uS/cm	89	76	2.0
pH	pH	9.15	9.11	N/A
Anions				
Alkalinity (PP as CaCO3)	mg/L	3.5	3.8	1.0
Alkalinity (Total as CaCO3)	mg/L	34	33	1.0
Bicarbonate (HCO3)	mg/L	32	31	1.0
Carbonate (CO3)	mg/L	4.2	4.6	1.0
Hydroxide (OH)	mg/L	<1.0	<1.0	1.0
Dissolved Chloride (Cl)	mg/L	2.8	1.7	1.0
Dissolved Sulphate (SO4)	mg/L	8.4	4.7	1.0
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	<0.010	0.010
Dissolved Nitrate plus Nitrite (N)	mg/L	0.10	0.058	0.010
Lab Filtered Elements				
Dissolved Calcium (Ca)	mg/L	4.8	4.5	0.30
Dissolved Iron (Fe)	mg/L	<0.060	<0.060	0.060
Dissolved Magnesium (Mg)	mg/L	6.6	5.6	0.20
Dissolved Manganese (Mn)	mg/L	<0.0040	<0.0040	0.0040
Dissolved Potassium (K)	mg/L	1.4	1.2	0.30
Dissolved Sodium (Na)	mg/L	2.1	1.4	0.50

RDL = Reportable Detection Limit
N/A = Not Applicable

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REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		ZT5148	ZT5149	
Sampling Date		2021/05/08 11:30	2021/05/09 10:45	
COC Number		635648-01-01	635648-01-01	
	UNITS	SOIL FLUSH #1	SOIL FLUSH #2	RDL
Elements				
Total Cadmium (Cd)	ug/L	0.53	0.44	0.020
Total Aluminum (Al)	mg/L	6.1	4.0	0.0030
Total Antimony (Sb)	mg/L	0.00076	<0.00060	0.00060
Total Arsenic (As)	mg/L	0.019	0.0094	0.00020
Total Barium (Ba)	mg/L	0.35	0.24	0.010
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010
Total Boron (B)	mg/L	<0.020	<0.020	0.020
Total Calcium (Ca)	mg/L	180	210	0.30
Total Chromium (Cr)	mg/L	0.013	0.020	0.0010
Total Cobalt (Co)	mg/L	0.0095	0.0071	0.00030
Total Copper (Cu)	mg/L	0.015	0.0097	0.00020
Total Iron (Fe)	mg/L	17	12	0.060
Total Lead (Pb)	mg/L	0.010	0.0073	0.00020
Total Lithium (Li)	mg/L	0.021	<0.020	0.020
Total Magnesium (Mg)	mg/L	39	45	0.20
Total Manganese (Mn)	mg/L	0.81	0.74	0.0040
Total Molybdenum (Mo)	mg/L	0.0020	0.0025	0.00020
Total Nickel (Ni)	mg/L	0.024	0.016	0.00050
Total Phosphorus (P)	mg/L	0.73	0.63	0.10
Total Potassium (K)	mg/L	3.5	2.5	0.30
Total Selenium (Se)	mg/L	0.00037	0.00022	0.00020
Total Silicon (Si)	mg/L	12	8.1	0.10
Total Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010
Total Sodium (Na)	mg/L	2.2	1.4	0.50
Total Strontium (Sr)	mg/L	0.21	0.21	0.020
Total Sulphur (S)	mg/L	2.0	1.4	0.20
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020
Total Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010
Total Titanium (Ti)	mg/L	0.045	0.032	0.0010
Total Uranium (U)	mg/L	0.0014	0.0012	0.00010
Total Vanadium (V)	mg/L	0.021	0.015	0.0010
Total Zinc (Zn)	mg/L	0.12	0.073	0.0030
RDL = Reportable Detection Limit				

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COMMERCIAL ACCOUNTS - CALGARY BUREAU VERITAS CANADA (2019) INC.

RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		ZT5148	ZT5149	
Sampling Date		2021/05/08 11:30	2021/05/09 10:45	
COC Number		635648-01-01	635648-01-01	
	UNITS	SOIL FLUSH #1	SOIL FLUSH #2	RDL
Physical Properties				
Turbidity	NTU	>4000 (1)	1600	0.10

RDL = Reportable Detection Limit
(1) Sample contained sediment

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MERCURY BY COLD VAPOR (WATER)

BV Labs ID		ZT5149	
Sampling Date		2021/05/09 10:45	
COC Number		635648-01-01	
	UNITS	SOIL FLUSH #2	RDL
Elements			
Total Mercury (Hg)	ug/L	0.0030	0.0019
RDL = Reportable Detection Limit			

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.7°C
Package 2	7.3°C

Version #3: Report reissued only with sample Soil Flush #1 & #2 as per client request. 20210531
Version #2: Report reissued due to typo error with email address. 20210519

Sample ZT5148 [SOIL FLUSH #1] : Turbidity completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes. NO2 - NO2 + NO3 (N) in Water completed within 48h after laboratory receipt to a maximum of five days from sampling. Data are satisfactory for compliance purposes.

Results relate only to the items tested.

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BV Labs Job #: C130760
Report Date: 2021/05/31

QUALITY ASSURANCE REPORT

COMMERCIAL ACCOUNTS - CALGARY BUREAU VERITAS CANADA (2019) INC.

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A221986	Turbidity	2021/05/12			102	80 - 120	<0.10	NTU	0.83	20
A223437	Total Mercury (Hg)	2021/05/12	93	80 - 120	97	80 - 120	<0.0019	ug/L	NC	20
A223560	Total Barium (Ba)	2021/05/16	96	80 - 120	106	80 - 120	<0.010	mg/L	5.4	20
A223560	Total Boron (B)	2021/05/16	103	80 - 120	107	80 - 120	<0.020	mg/L	2.2	20
A223560	Total Calcium (Ca)	2021/05/16	NC	80 - 120	108	80 - 120	<0.30	mg/L	3.3	20
A223560	Total Iron (Fe)	2021/05/16	118	80 - 120	107	80 - 120	<0.060	mg/L	3.4	20
A223560	Total Lithium (Li)	2021/05/16	108	80 - 120	112	80 - 120	<0.020	mg/L	4.7	20
A223560	Total Magnesium (Mg)	2021/05/16	NC	80 - 120	113	80 - 120	<0.20	mg/L	0.90	20
A223560	Total Manganese (Mn)	2021/05/16	109	80 - 120	105	80 - 120	<0.0040	mg/L	2.5	20
A223560	Total Phosphorus (P)	2021/05/16	104	80 - 120	104	80 - 120	<0.10	mg/L	NC	20
A223560	Total Potassium (K)	2021/05/16	NC	80 - 120	110	80 - 120	<0.30	mg/L	2.4	20
A223560	Total Silicon (Si)	2021/05/16	113	80 - 120	113	80 - 120	<0.10	mg/L	5.4	20
A223560	Total Sodium (Na)	2021/05/16	NC	80 - 120	107	80 - 120	<0.50	mg/L	1.4	20
A223560	Total Strontium (Sr)	2021/05/16	94	80 - 120	106	80 - 120	<0.020	mg/L	3.1	20
A223560	Total Sulphur (S)	2021/05/16	NC	80 - 120	109	80 - 120	<0.20	mg/L	0.77	20
A223574	Total Aluminum (Al)	2021/05/13	112	80 - 120	116	80 - 120	<0.0030	mg/L	6.4	20
A223574	Total Antimony (Sb)	2021/05/13	113	80 - 120	116	80 - 120	<0.00060	mg/L	1.3	20
A223574	Total Arsenic (As)	2021/05/13	103	80 - 120	102	80 - 120	<0.00020	mg/L	0.17	20
A223574	Total Beryllium (Be)	2021/05/13	114	80 - 120	108	80 - 120	<0.0010	mg/L	NC	20
A223574	Total Chromium (Cr)	2021/05/13	104	80 - 120	105	80 - 120	<0.0010	mg/L	NC	20
A223574	Total Cobalt (Co)	2021/05/13	101	80 - 120	104	80 - 120	<0.00030	mg/L	3.2	20
A223574	Total Copper (Cu)	2021/05/13	97	80 - 120	104	80 - 120	<0.00020	mg/L	14	20
A223574	Total Lead (Pb)	2021/05/13	100	80 - 120	106	80 - 120	<0.00020	mg/L	NC	20
A223574	Total Molybdenum (Mo)	2021/05/13	117	80 - 120	110	80 - 120	<0.00020	mg/L	5.2	20
A223574	Total Nickel (Ni)	2021/05/13	98	80 - 120	105	80 - 120	<0.00050	mg/L	11	20
A223574	Total Selenium (Se)	2021/05/13	113	80 - 120	115	80 - 120	<0.00020	mg/L	0.93	20
A223574	Total Silver (Ag)	2021/05/13	102	80 - 120	105	80 - 120	<0.00010	mg/L	NC	20
A223574	Total Thallium (Tl)	2021/05/13	108	80 - 120	113	80 - 120	<0.00020	mg/L	NC	20
A223574	Total Tin (Sn)	2021/05/13	109	80 - 120	103	80 - 120	<0.0010	mg/L	NC	20
A223574	Total Titanium (Ti)	2021/05/13	110	80 - 120	103	80 - 120	<0.0010	mg/L	NC	20
A223574	Total Uranium (U)	2021/05/13	103	80 - 120	105	80 - 120	<0.00010	mg/L	2.6	20
A223574	Total Vanadium (V)	2021/05/13	107	80 - 120	105	80 - 120	<0.0010	mg/L	5.9	20
A223574	Total Zinc (Zn)	2021/05/13	100	80 - 120	106	80 - 120	<0.0030	mg/L	NC	20

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
A223796	Dissolved Calcium (Ca)	2021/05/16	NC	80 - 120	99	80 - 120	<0.30	mg/L	1.1	20
A223796	Dissolved Iron (Fe)	2021/05/16	111	80 - 120	104	80 - 120	<0.060	mg/L	NC	20
A223796	Dissolved Magnesium (Mg)	2021/05/16	NC	80 - 120	102	80 - 120	<0.20	mg/L	1.9	20
A223796	Dissolved Manganese (Mn)	2021/05/16	108	80 - 120	102	80 - 120	<0.0040	mg/L	3.3	20
A223796	Dissolved Potassium (K)	2021/05/16	104	80 - 120	104	80 - 120	<0.30	mg/L	1.3	20
A223796	Dissolved Sodium (Na)	2021/05/16	NC	80 - 120	96	80 - 120	<0.50	mg/L	1.4	20
A223798	Dissolved Calcium (Ca)	2021/05/14	NC	80 - 120	101	80 - 120	<0.30	mg/L	1.8	20
A223798	Dissolved Iron (Fe)	2021/05/14	110	80 - 120	105	80 - 120	<0.060	mg/L	NC	20
A223798	Dissolved Magnesium (Mg)	2021/05/14	NC	80 - 120	103	80 - 120	<0.20	mg/L	2.8	20
A223798	Dissolved Manganese (Mn)	2021/05/14	109	80 - 120	103	80 - 120	<0.0040	mg/L	1.1	20
A223798	Dissolved Potassium (K)	2021/05/14	104	80 - 120	105	80 - 120	<0.30	mg/L	2.7	20
A223798	Dissolved Sodium (Na)	2021/05/14	NC	80 - 120	99	80 - 120	<0.50	mg/L	2.3	20
A223899	Dissolved Nitrate plus Nitrite (N)	2021/05/12	122 (1)	80 - 120	99	80 - 120	<0.010	mg/L	1.1	20
A223899	Dissolved Nitrite (N)	2021/05/12	100	80 - 120	104	80 - 120	<0.010	mg/L	NC	20
A225434	Alkalinity (PP as CaCO3)	2021/05/14					<1.0	mg/L	NC	20
A225434	Alkalinity (Total as CaCO3)	2021/05/14			98	80 - 120	<1.0	mg/L	1.5	20
A225434	Bicarbonate (HCO3)	2021/05/14					<1.0	mg/L	2.0	20
A225434	Carbonate (CO3)	2021/05/14					<1.0	mg/L	NC	20
A225434	Hydroxide (OH)	2021/05/14					<1.0	mg/L	NC	20
A225437	pH	2021/05/14			100	97 - 103			0.16	N/A
A225438	Conductivity	2021/05/14			101	90 - 110	<2.0	uS/cm	0.65	10
A226330	Dissolved Chloride (Cl)	2021/05/15	99	80 - 120	105	80 - 120	<1.0	mg/L	NC	20
A226330	Dissolved Sulphate (SO4)	2021/05/15	105	80 - 120	106	80 - 120	<1.0	mg/L	NC	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Sandy Yuan, M.Sc., QP, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories Calgary: 2021 - 41st Avenue N.E. T2E 6P2 Telephone (403) 291-3077 Fax (403) 291-9468

Bureau Veritas Laboratories
4000 19st N.E, Calgary, Alberta Canada T2E 6P8 Tel:(403) 291-3077 Toll-free:800-563-6266 Fax:(403) 291-9468 www.bvlabs.com

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CHAIN OF CUSTODY RECORD

Page of

INVOICE TO:

Company Name: #10311 COMMERCIAL ACCOUNTS - CALGARY BUR
Attention: [redacted]
Address: [redacted]
Calgary AB T2E 6P8
Tel: [redacted] Fax:
Email: [redacted]

REPORT TO:

Company Name: JON FENNELL
Attention: [redacted]
Address: [redacted]
Tel: [redacted]
Email: [redacted]

PROJECT INFORMATION:

Quotation #: [redacted]
P.O. #:
Project: [redacted]
Project Name: [redacted]
Site #: [redacted]
Sampled By: [redacted]

Laboratory Use Only:

BV Labs Job #:
Bottle Order #: 635648
COC #: C#635648-01-01
Project Manager: Customer Solutions

Regulatory Criteria:
- [x] ATI
- [x] CCME
- [ ] Other

Special Instructions

SAMPLES MUST BE KEPT COOL (< 10°C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Metals Field Filtered ? (Y / N)	Routine Water -Lab Filtered	Regulated Metals (CCME/AT1) - Total	Turbidity	MERCURY (TOTAL)						# of Bottles	Comments
1		SOIL FLUSH #1	MAY 8/21	11:30	W	N	✓	✓	✓							3	
2		SOIL FLUSH #2	MAY 9/21	10:45	W	N	✓	✓	✓	✓						4	
3		[redacted]			W	N	✓	✓	✓							3	
4		Need certificate/chemistry of DI water.															
5																	
6																	
7																	
8																	
9																	
10																	

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☐
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests are > 5 days - contact your Project Manager for details

Job Specific Rush TAT (if applies to entire submission) ☐
Date Required:
Rush Confirmation Number: (call lab for #)

10-May-21 08:10
Customer Solutions
C130760
JK4 INS-0088

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
JON FENNELL	21/05/09	12:00	[redacted]	21/05/09	12:00	
			Jessica Lee [redacted]	20210510	08:10	

Laboratory Use Only

Time Sensitive	Temperature (°C) on Receipt	Custody Seal Intact on Cooler?
☐	6,6,5 ICE:Y 10,6,6 ICE:N SEAL:N	☐ Yes ☑ No

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.
* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.
** ALL SAMPLES ARE HELD FOR 60 DAYS AFTER SAMPLE RECEIPT, FOR SPECIAL REQUESTS CONTACT YOUR PROJECT MANAGER

White: BV Labs Yellow: Client